

CONTENTS

	PAGE
Harvest Maturity Study	3
Experimental Procedure	4
Discussion of Results	7
Characteristics of Harvested Fruit	7
Ground and Flesh Color	7
Surface Blush	8
Weight	9
Ring Size, Circumference and Diameters	10
Pressure Tests	11
Tenderometer Readings	13
Pit Browning	16
Soluble and Total Solids	17
Wilting Losses	17
Harvesting Maturity and Dessert Quality	18
Flavor	18
Texture	20
Color	20
Handling Qualities	20
Ripening Study	22
Experimental Procedure	22
Discussion of Results	25
Ripening Method and Dessert Quality	25
Effect of Harvest Maturity and Ripening Conditions on Pit Loss, Yield, Total Loss, Net Loss and Drained Weight	27
Summary	30

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FREESTONE PEACHES have been grown in Michigan since 1775 and have been commercially produced since 1848. Commercial canning of peaches began about 1934 and commercial freezing about 1944. The total production and utilization of peaches in Michigan from 1931 to 1952 are shown in Fig. 1.

The freestone peaches of Michigan are capable of yielding a choice processed fruit when properly handled. However, with the production of peaches in the United States increasing rapidly in recent years, the future development of freestone peach processing in Michigan will depend upon the improvement in methods of production, handling and processing to reduce costs. Production of a high quality processed fruit will be necessary to increase consumption in a highly competitive market.

This paper presents the data of recent studies on the relation of various factors in harvesting, handling and processing of this crop to quality. In this study, the Elberta and Halehaven varieties were used since they are most commonly used for processing in Michigan (Johnston, 1953).

HARVEST MATURITY STUDY

The quality of both canned and frozen freestone peaches is markedly affected by the maturity of the fruit when harvested. There has been a lack of agreement between various investigators as to the stages of maturity at which peaches can be harvested and successfully ripened for processing.

This study, carried out in 1950, 1951 and 1952, was undertaken to determine the best maturity range for harvesting peaches for canning and freezing in Michigan.

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EXPERIMENTAL PROCEDURE

The peaches used in this study were from Halehaven and Elberta planted in 1940 in a commercial orchard near South Lyon, Michigan. The trees were in a good state of productivity and vigor were selected for uniformity in size and fruit load.

The first pickings were made when the peaches required from 19 days to ripen after picking. Additional pickings were made two-day intervals until the fruit reached tree ripeness. Only twoings were made from each tree to minimize the effect of fruit

removal on the rate of growth or ripening of the peaches, and these were made on alternate days.

Approximately 80 pounds of fruit were picked at random for each maturity lot. The fruit was picked in the morning and immediately taken to the laboratory where it was sorted on the basis of ground color to obtain a uniform maturity lot of the harvest and to eliminate peaches which varied considerably from the typical maturity of the picking.

A description of fruit maturity was made for each harvest. For this, a 60-fruit sample was selected at random from each maturity lot. Twenty fruits were used for detail measurements and descriptions, and 40 fruits were used for tenderometer determinations.

Fruit descriptions: The following fruit descriptions and measurements were made on samples taken from each maturity lot.

Weight: Each fruit was weighed to the nearest gram.

Ground color and flesh color: Numerical values were given ground and flesh color, using the apple color chart (Magness *et al.*, 1926).

Blush: The percent of blush, based on fruit surface covered by a distinct blush, was estimated.

Ring size: The ring size of each fruit was determined with the standard fruit inspector's size gauge.

Circumference: Circumference was measured to the nearest millimeter at the point of greatest transverse circumference.

Pressure tests: Pressure tests were made with the standard pressure tester (Magness and Taylor, 1925) using 5/16 and 7/16 inch plungers. Four pressure test readings were made on the peeled surfaces—near the center of the suture, on each cheek and on the back. The right and left cheek locations were determined by holding the suture side of the peach forward with the stem upward. The back location was directly opposite the suture.

Diameters: Measurements to the nearest millimeter were made at the greatest diameter between cheeks, suture to back, and stem to apex.

Pit browning: The approximate percent of pit surface which had become brown or oxidized.

Tenderometer values: The tenderometer values were determined on both unpeeled and peeled fruit using a FMC tenderometer with

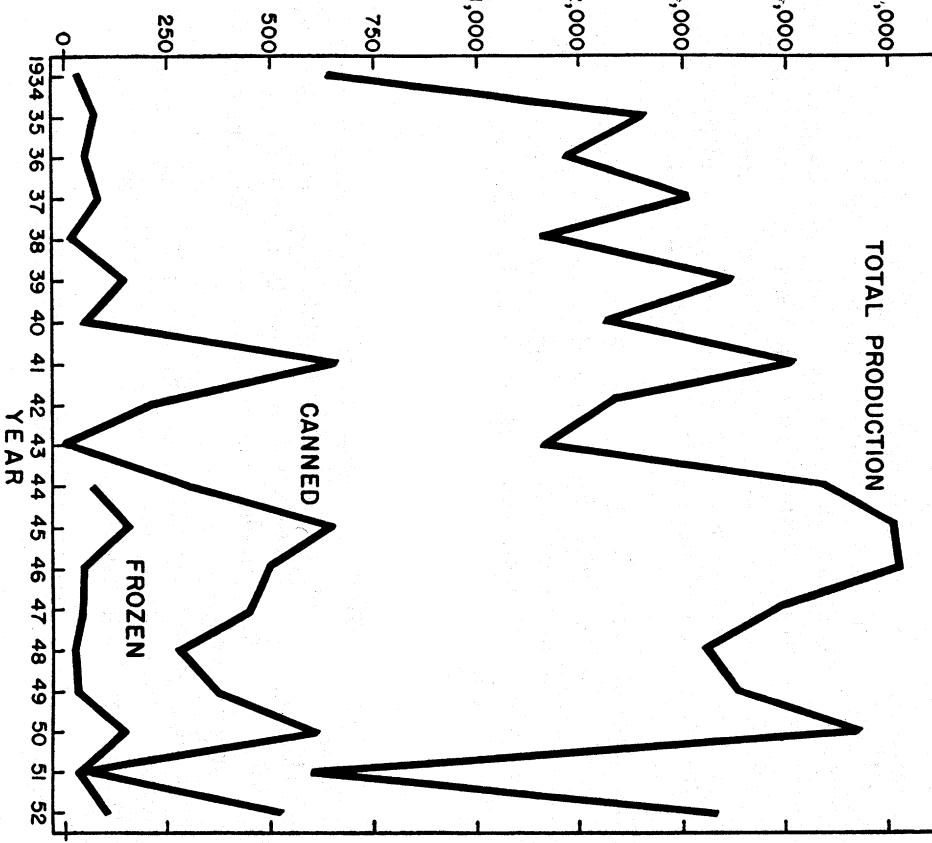


Fig. 1. Peach production and utilization in Michigan, 1934-1952. (From Michigan Agricultural Statistics, Michigan Department of Agriculture, May 1953.)

standard chamber and shearing knives. The following procedures were used:

Halves. One half was placed in the chamber, cup down and stem end upwards. Readings for each half were determined. Quarters. The peaches were quartered and two quarters were placed in the chamber longitudinally with the skin side up for each reading.

Slices. The peaches were halved and sliced into twelfths; 150-gram samples were placed in the chamber.

Cubes. The peaches were cut into cubes with a cuber having 0.375 inch square openings in the faceplate. A 150-gram sample was placed in the tenderometer chamber.

Total and soluble solids: The total solids were determined by the vacuum oven method. Soluble solids determinations were made on the expressed juice of pulped fruit with an Abbe type refractometer.

Ripening method: Thirty-pound lots of each maturity were placed in a ripening cabinet so constructed that the relative humidity could be maintained between 50 and 70 percent by means of vents. The ripening cabinet was held at room temperature and the fruit temperatures varied from 65° to 85° F., averaging 70° F., during ripening. The number of peaches and weight of each lot was recorded. The fruit was considered ready for processing when it was fully colored, soft and peeled readily after steam treatment.

Processing method: On the first day each lot reached processing ripeness, it was re-weighed to determine loss in weight. Sufficient fruit was weighed and prepared for processing. The individual fruits were halved, pitted, and placed face down on aluminum sheets. The halves were then steamed for 60 seconds, cooled with a short spray of cold water and the skins slipped off by hand. Observations were made on color, freeness of pits and ease of peeling for each lot. Pit loss, skin loss and yield were determined.

For canning, the prepared halves were accurately weighed into No. 2 peach cans to 14½ ounces, siruped with hot (180°-190° F.) 40 percent sucrose solution and exhausted in boiling water for 7 minutes. The cans were then sealed, cooked for 20 minutes in boiling water and water cooled. The canned samples were stored at 55° F. until examined.

Frozen samples were prepared by slicing the peeled halves into 6 uniform slices. Twelve ounces of fruit and 5 ounces of cold 40

percent sucrose sirup, containing 175 mg. of ascorbic acid, were filled into pint Marapak bags in cartons. The bags were heat sealed with a minimum of entrapped air, frozen in an air blast plate freezer at -10° F. and stored at 0° F. until examined.

Evaluation of Processed Fruit. Canned and frozen samples were examined for quality four to six months after processing. A comparison of frozen samples thawed at room temperature and thawed in warm water (100° F.) for 20 minutes showed no differences in quality; therefore, most of the frozen samples were thawed in warm water to reduce time of thawing for examination. All samples of a variety were compared with each other in each year's study. The color, texture, flavor and general appearance were compared, and the drained weight was determined.

DISCUSSION OF RESULTS

Characteristics of harvested fruit: The measurements on each of 20 fruits from the various maturity samples of the three years' study gave a mass of data, and only the averages are presented for each maturity lot in Tables 1 to 4. Since the reliability of an average or mean is dependent to a large extent upon the variability of the individual numbers from which the average was derived, it seemed desirable to determine the coefficients of variation in percent of the measurements made. Since the results were similar for both varieties and for the three years, only the results obtained for the Elberta variety in 1951 are presented in Table 5.

The smallest coefficient of variations occurred in the measurements of ring size, circumference and diameters of the whole peaches and tenderometer values of the sliced and cubed peaches. Weight gave moderate values for coefficient of variation. The values for the pressure tests and tenderometer values of the halves and quarters were generally moderate for the fruit requiring 8 or more days to ripen, but tended to be erratic and high for fruit requiring less than 8 days to ripen.

Ground and flesh color. The ground and flesh color of the peaches ranged from full green to golden yellow. A comparison of the results obtained in the three years' study on the Elberta showed considerable variation in the development of the yellow color (Tables 2 to 4). In 1950, the peaches harvested in the maturity range requiring 7 to 4

lys to ripen varied from 2.45 to 3.12 on the apple color chart; in 1951 in 2.9 to 3.3; and in 1952 from 3.3 to 3.6.

Since these fruits were harvested from the same block of trees in the same orchard, the variations reflected the influence of the weather conditions on the growth status of the tree and the maturation of the fruit. In 1951 and 1952, during the months of July and August, the rainfall in this area was below normal and in 1952 it became necessary to water the trees during the first week of September to protect them. The lack of sufficient moisture resulted in a more rapid development of the yellow color and the peaches appeared more mature than they actually were. This emphasized the limitations of using a color index exclusively for harvesting peaches and indicated the necessity of being familiar with the growing conditions under which the fruit matures in order to establish a ground color standard for harvesting.

Surface blush. The percent of surface blush was of little value as guide to maturity. It indicated exposure to sun rather than actual

TABLE 1—Summary of fruit measurements and description at harvest—
Halehaven

Date harvested.....	1950								
	9/8	9/10	9/12	9/14	9/16	9/18	9/20.		
8/27	8/29	8/31	9/2	8/18	8/20	8/22	8/24	8/26	8/26
Days to ripen.....	13	11	9	7	6	4	3	4	4
Ground color.....	2.0	2.0	2.0	2.5	2.8	3.1	4.0	4.2	4.4
Flesh color.....	2.0	2.7	2.9	3.8	3.8	4.0	4.2	4.4	4.4
Pit browning, %.....	0	3	6	12	17	12	59	77	77
Weight, gm.....	124	143	146	159	147	168	167	169	169
Ring size, in.....	2.5	2.7	2.7	2.8	2.7	2.9	2.9	2.8	2.8
Circumference, cm.....	19.9	20.6	20.8	21.3	20.9	21.8	21.5	22.0	22.0
Diameter, cm.....									
Suture.....	6.2	6.4	6.5	6.7	6.4	6.8	6.8	6.7	6.7
Cheek.....	5.7	6.2	6.2	6.3	6.0	6.4	6.2	6.3	6.3
Longitudinal.....	5.5	5.7	5.7	5.8	5.7	5.7	5.7	5.8	5.8
Pressure test, lbs.									
Cheek.....	18.7	17.3	15.2	12.7	14.5 ^a	14.7 ^a	6.2 ^a	8.8 ^a	8.8 ^a
Suture.....	15.8	14.1	11.9	7.0	9.4 ^a	7.6 ^a	4.9 ^a	5.3 ^a	5.3 ^a
Back.....	15.6	13.5	10.5	8.5	9.6 ^a	8.1 ^a	5.7 ^a	6.0 ^a	6.0 ^a
Tenderometer, lbs./sq. in.									
Halves, not peeled.....	...	104	70	58	43	48	41	34	35
Quarters, not peeled.....	...	68	58	43	34	34	7	6	7
Quarters, not peeled.....	...	97	94	87	61	61	33	30	30
Quarters, peeled.....	...	93	69	51	47	29	8	12	12
Quarters, peeled.....	...	132	95	100	62	..	..	..	..
Slices, peeled.....	...	85	65	67	12	12	12	18	18
Slices, peeled.....	...	121	81	72	66	66	40	40	40
Cubes, peeled.....	...	145	122	90	55	59	40	14	11
Cubes, peeled.....	...	143	9.6	8.7	10.6	10.1	11.8	10.7	11.0
Soluble solids, %.....	13.8	13.7	13.4	13.7	13.1	13.7	13.3	13.3	13.3
Total solids, %.....									

^a 7/16 inch plunger.

maturity, and with the Halehaven, particularly, interfered with the use of ground color as a maturity index.

Weight. Since it was not possible to make measurements on the same fruits throughout the growing period, errors in sampling are introduced and in some instances the data would appear to indicate that the fruit decreased in weight during some periods of growth. For this reason, only the over-all increases are considered. In 1951, the over-all increase in weight for the Halehavens was 30 percent during a 6-day growing period, and in 1952, 25 percent during an 8-day period. For the Elberta it was 36 percent during a 14-day period in 1950, 53 percent over 15 days in 1951 and 86 percent during 12 days in 1952.

The lower weight increase for the Halehavens in 1952 may be attributed, in part, to the lack of moisture during the latter part of the harvesting period.

The large gain in the weight of the Elberta fruits during the 1952 season reflected the lack of rainfall during the early part of the grow-

7/16 inch plunger.
No pressure.

No reading because of flesh softness.

ing season and the effect of watering during the later stages of maturation. In the 8-day period prior to watering, the fruit gained about 44 percent in weight and 2 days after watering there was an additional gain of 19 percent over the previous harvest.

The results of the 3-year study indicated that the grower would not gain much in yield in leaving his fruit on the trees after they had reached a maturity requiring 3 days or less to ripen. The weight increase tended to be more than offset by fruit dropping and from bruising during harvesting and handling.

Ring size, circumference and diameters. Ring size is used as the basis for size standards of peaches. With peaches having full round cheeks as the Halehavens, it is a fairly satisfactory measure. However, for the Elberta, where there is less tendency for the cheeks to fill out completely, ring size becomes merely a measure of suture diameter. The ring size, circumference, and diameters were found to increase with the weight as the fruit became more mature. The least increase occurred in the longitudinal diameter and most of this in-

TABLE 3.—Summary of fruit measurements and description at harvest—
Elberta

Date harvested.....	1951					
	8/29	8/31	9/2	9/4	9/6	9/8
Days to ripen.....	19	17	14	10	8	6
Ground color.....	1.7	2.2	2.3	2.7	3.1	3.3
Flesh color.....	2.0	2.2	2.4	2.7	3.0	3.3
Pit browning, %.....	0	2	2	4	13	10
Weight, gms.....	79	80	97	87	101	112
Ring size, in.....	2.1	2.1	2.2	2.1	2.2	2.2
Circumference, cm.....	16.9	16.8	17.9	16.9	17.6	18.0
Suture, cm.....	5.3	5.3	5.6	5.5	5.6	5.7
Cheek.....	5.0	5.0	5.4	5.1	5.3	5.4
Longitudinal.....	5.4	5.4	5.4	5.3	5.5	5.6
Pressure test, lbs.....	21.8	18.5	17.1	16.9	16.4	15.9
Cheek.....	19.7	16.0	14.5	14.3	13.0	12.5
Back.....	23.3	18.7	16.9	14.9	13.8	13.3
Tendrometer, lbs./sq. in.....	...	66	74	60	67	65
Halves, not peeled.....	...	47	49	41	44	35
Halves, peeled.....	...	89	98	73	80	84
Quarters, not peeled.....	...	58	56	53	58	55
Quarters, peeled.....	...	180	162	132	126	123
Slices, not peeled.....	...	154	135	122	100	93
Slices, peeled.....	...	168	140	125	108	113
Cubes, not peeled.....	...	158	122	99	78	83
Cubes, peeled.....	...	12.0	10.3	10.7	11.4	11.9
Total solids, %.....	14.0	14.1	14.2	13.4	14.8	14.2
Total solids, %.....	14.0	14.1	14.2	13.4	14.8	14.2

^a 7/16 inch plunger.
^b No reading because of flesh softness.

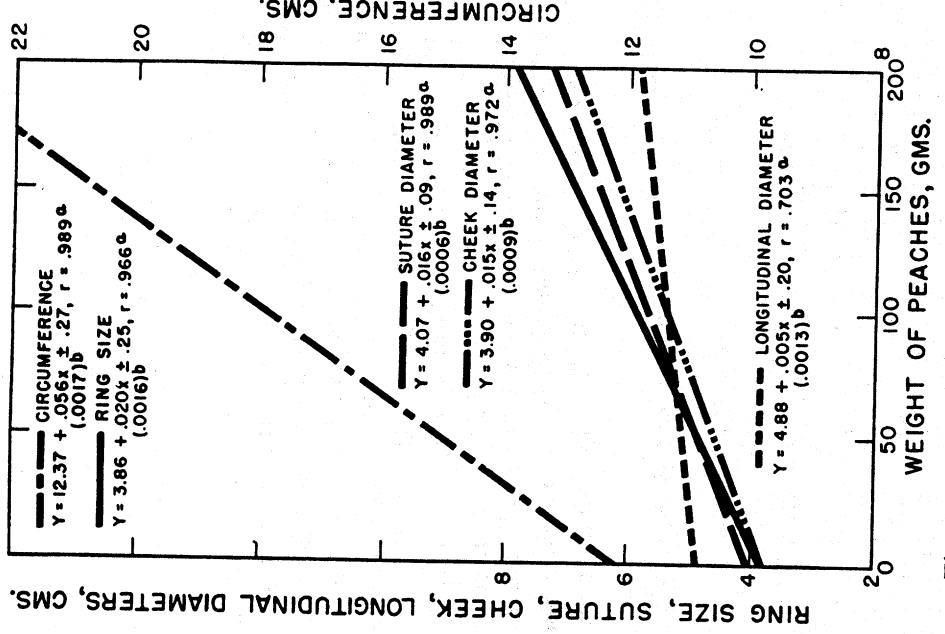


Fig. 2. Regression of ring size, suture, cheek and longitudinal diameters and circumference on weight of peaches.
^a Significant 1% level
^b Standard error of regression coefficient

crease occurred during the initial stages of maturity covered in this study. Statistical correlations between these measurements and weight were found to be very high (Fig. 2).

Pressure tests. The data obtained showed the characteristic softening of the peaches during ripening, and that softening was more rapid at the suture than on the cheeks. A comparison of the data obtained for the Elberta showed that in 1950 fruits having an average pressure test of 14 pounds or less with the 5/16 inch plunger on the pared

cheeks ripened to give good quality products. In 1951 the firmness averaged 11 pounds or less, and in 1952 it was 13 pounds or less for similar quality. The pressure tests on the sutures averaged 2 pounds lower than those on the cheeks. Similar results were obtained for the Halehavens. It was noted also that occasionally greener fruits of a later harvest were softer than those of an earlier picking requiring the same ripening time.

The inconsistencies obtained during this study showed that there are definite limitations in the use of the pressure test as an index of peach maturity and indicated the difficulty in establishing a maximum value at which peaches could be harvested and yield a good quality product when ripened. These results are in agreement with those previously reported by other investigators (Haller, 1952). However, under Michigan conditions, it would seem that peaches testing more than 12 pounds on the pared cheeks at harvest generally could not be expected to yield a good quality product when ripened. This standard, used in conjunction with ground color, would aid in establishing a color index for the pickers and would help eliminate

TABLE 4—Summary of fruit measurements and description at harvest—*Elberta*

Date harvested.....	1952							Ripe 9/13
	8/30	9/1	9/3	9/5	9/7	9/9	9/11	
Days to ripen.....	19	17	14	10	8	8	6	4
Weight, gms.....	15.48	10.22	15.88	7.95	15.37	11.51	11.30	12.13
Ring size.....	11.52	4.97	6.55	5.33	7.24	5.27	3.19	3.62
Circumference, cm.....	5.64	3.94	5.76	3.16	6.03	4.92	4.66	4.34
Pressure, lbs.....								4.01
Back.....	13.73	13.01	12.30	12.33	14.32	11.85	21.51	64.49
Suture.....	12.65	12.02	6.86	15.92	15.67	8.20	51.73	...
Cheek 1.....	8.09	7.08	9.17	9.23	11.44	8.20	20.34	54.06
Cheek 2.....	7.08	5.75	6.88	7.76	6.81	10.50	20.03	56.78
Diameter, cm.....								7.50
Suture.....	4.97	3.52	5.59	2.89	5.54	3.78	4.00	3.99
Longitudinal.....	4.72	3.45	5.40	2.86	3.32	4.50	4.36	3.95
Cheek.....	7.41	4.79	6.47	4.14	6.69	4.91	5.26	5.06
Tenderometer.....								3.06
Halves, not peeled.....	16.95	9.27	10.33	14.89	19.20	19.55	18.54	15.25
Halves, peeled.....	14.76	13.30	12.65	17.53	19.38	30.52	32.06	10.67
Quarters, not peeled.....	6.00	9.41	14.87	16.11	29.28	20.39	47.30	30.78
Quarters, peeled.....	10.17	15.35	16.77	16.20	9.93	22.48	56.60	13.10
Slices, not peeled.....	2.22	2.79	0.90	7.98	6.77	11.10	35.35	16.39
Slices, peeled.....	2.00	2.56	5.74	2.00	1.69	6.06	16.22	32.17
Cubes, not peeled.....	1.37	4.37	5.32	5.28	2.85	0.96	5.74	39.80
Cubes, peeled.....	13.70	8.86	13.20	5.20	6.37	1.61	1.57	11.36

7/16 inch plunger.

TABLE 5—Coefficient of variation of measurements of peach maturity — Percent *Elbertas*—1951

Harvest date.....	1952					Ripe 9/13
	8/29	8/31	9/2	9/4	9/6	
Pressure values 5/16*						
Hale- haven						
Elberta						
Back.....	.952	.950	.951	.952	.952	.952
Cheek (avg).....	.991	...	.974	.926	.916	.974
Suture.....	.986	.778	.922	.938	.831	.976

the harvesting of immature fruit. Haller and Smith (1953) reported that Elberta peaches testing 16 pounds or more on pared cheeks should be graded immature.

Tenderometer readings. The results obtained with the tenderometer indicated that it could be used for determining flesh firmness and, indirectly, maturity of peaches. However, similar limitations apply to the tenderometer as to the use of the pressure test for an index of fruit maturity. The data obtained showed greater consistency when either peeled slices or cubes were used.

TABLE 9—Effect of harvest maturity on wilting loss, pit loss, skin loss yield and drained weight—Halehaven, 1951-52

Days ripened	Wilting loss %	Pit loss %	Skin loss %	Yield		Drained weight Canned ozs.	Frozen ozs.	Flavor score
				Canned %	Frozen %			
1951								
6.....	7.4	8.0	5.4	87.1	86.3	14.5	9.6	3.1
7.....	9.4	8.5	5.2	86.3	85.5	15.0	9.7	3.1
5.5.....	5.5	7.0	6.3	86.9	85.9	13.5	9.4	3.1
4.....	6.7	7.7	4.9	87.4	85.9	14.0	9.5	3.1
5.....	0.1	5.4	8.2	87.6	81.5	13.5	9.3	2.1
2.....	1.2	6.4	5.2	88.4	86.5	13.2	9.3	2.1
3.....	1.1	6.5	6.1	87.4	87.3	13.1	9.3	2.1
1.....	3.6	6.7	5.5	88.6	86.4	13.6	9.4	2.1
3.....								
1952								
12.....	13.3	8.4	5.0	85.8	83.5	14.3	11.1	1.1
10.....	10.8	8.2	5.3	87.7	85.4	14.4	10.6	2.1
8.....	10.6	7.5	5.1	87.2	84.9	14.4	10.5	3.1
6.....	6.4	7.3	5.3	86.0	83.8	14.1	10.5	4.1
5.....	7.4	7.2	5.6	90.4	91.4	14.2	10.2	4.1
4.....	5.6	7.7	5.2	87.9	83.2	14.1	10.3	4.1
3.....	4.2	6.3	5.8	88.3	89.5	13.9	10.5	4.1
2.....	1.3	6.0	9.0	83.5	83.5	13.4	10.8	3.1
1.....	1.2	6.6	7.8	85.7	83.7	13.2	10.8	3.1

* 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Fair, 1 = Poor.

TABLE 7—Temperature and humidity ranges for each ripening method

Actual temperature for each ripening condition	Actual relative humidity for each ripening method	
	Range °F.	Average °F.
75° F. Moderate Humidity..	74-76	75
75° F. High Humidity.....	74-76	75
85° F. Moderate Humidity..	84-88*	85
85° F. High Humidity.....	84-92*	85
95° F. Moderate Humidity..	94-96	95
95° F. High Humidity.....	94-96	95
	77-93	85

*High temperature occurred during first two days of ripening greener fruit.

TABLE 8—Peach descriptions—ripening study

Measurement	Halehaven				Elberta				Days ripened	Wilting loss %	Pit loss %	Skin loss %	Yield Canned %	Yield Frozen %	Drained weight Canned ozs.	Drained weight Frozen ozs.	Flavor scor
	1951	1952	1950	1951	1952	1951	1952	1952									
Days ripened.....	4-7	6-10	3-7	6-9	2-5	8-12	3-7	7-13	4-8								
Weight, gms.....	100	99	130	147	167	99	108	120	165								
Ground color, average.....	3.0	2.7	3.7	3.1	4.0	2.6	3.4	3.3	3.6								
Ring size, in.....	2.3	2.4	2.7	2.8	2.9	2.2	2.4	2.6	2.9								
Circumference, cm.....	18.5	18.5	20.7	20.9	21.5	17.6	18.7	19.4	21.7								
Pressure test, lbs.																	
Back.....	5.0	9.3	6.1 ^a	9.6	5.7 ^a	13.8	5.4 ^a	12.1	4.1 ^a								
Suture.....	4.3	10.9	5.6 ^a	9.4	4.9 ^a	13.0	4.1 ^a	12.8	2.6 ^a								
Cheek, average.....	6.5	12.6	7.8 ^a	14.5	6.2 ^a	16.4	8.3 ^a	14.9	6.4 ^a								
Diameter, cms.																	
Suture.....	5.7	5.7	6.3	6.4	6.8	5.6	5.9	6.0	6.7								
Longitudinal.....	5.5	4.8	5.0	5.7	5.7	5.5	5.5	5.2	5.7								
Cheek.....	5.7	5.6	6.2	6.0	6.2	5.3	5.7	5.8	6.6								
Flesh color.....	3.6	3.1	3.9	3.8	4.0	3.1	3.8	3.6	4.0								
Pit browning, %.....	21	20	39	16	59	13	50	8	63								
Tenderometer, lbs.																	
Slices.....	53	80	37	67	12	100	17	77	31								
Cubes.....	37	68	34	58	14	78	16	84	16								
Soluble solids (R.I.).....	10.5	12.9	11.4	10.1	10.7	11.9	12.2	12.4	12.9								
Total solids, %.....	12.3	13.8	13.2	13.1	14.4	14.8	13.9	14.2	14.2								
pH.....	3.7	3.6	3.7	3.6	3.7	3.7	3.7	3.7	3.6								

* 7/16 inch plunger.

TABLE 10—Effect of ripening conditions on wilting loss, pit loss, skin loss yield and drained weight—Halehaven, 1951

75° F. Moderate Humidity	4	Days ripened	Wilting loss %	Pit loss %	Skin loss %	Yield		Drained weight Canned ozs.	Drained weight Frozen ozs.	Flavor scor
						Canned %	Frozen %			
75° F. High Humidity	5	4	15.7	8.5	5.8	85.7	83.5	14.8	10.3	3
75° F. High Humidity	5	5	16.9	8.5	5.4	84.5	82.3	15.0	10.8	3
75° F. High Humidity	7	24.7	9.7	5.0	86.2	83.9	15.1	11.1	3	3
85° F. Moderate Humidity	4	9.3	8.5	7.7	83.8	81.6	14.5	10.3	3	3
85° F. Moderate Humidity	5	10.4	7.3	4.7	86.2	83.9	14.5	11.0	3	3
85° F. Moderate Humidity	7	13.9	8.8	6.0	87.8	85.5	14.8	10.3	3	3
85° F. Moderate Humidity	4	13.6	9.3	6.3	84.4	82.2	14.8	10.3	3	3
85° F. Moderate Humidity	5	16.9	7.8	4.8	85.8	83.6	15.4	10.8	2	2
85° F. Moderate Humidity	7	22.3	8.8	6.0	86.4	84.2	15.4	11.0	2	2
95° F. Moderate Humidity	4	7.3	7.7	6.5	86.3	84.1	14.1	10.0	3	3
95° F. Moderate Humidity	5	9.0	7.7	5.0	86.9	84.6	14.6	10.0	2	2
95° F. Moderate Humidity	7	11.5	9.8	6.0	87.3	85.0	14.8	10.0	2	2
95° F. High Humidity	4	18.4	8.2	9.1	82.2	80.1	14.9	10.9	3	3
95° F. High Humidity	5	22.0	9.1	9.7	81.4	79.3	15.5	10.8	2	2
95° F. High Humidity	7	30.8	9.4	7.9	83.6	81.4	15.9	11.5	1	1
95° F. High Humidity	4	9.4	7.6	11.8	78.0	77.3	14.3	10.6	2	2
95° F. High Humidity	5	13.4	8.2	8.8	79.3	77.3	14.4	11.0	2	2
95° F. High Humidity	7	17.3	8.8	8.8	80.5	80.5	14.4	11.1	1	1

* 5 = Excellent, 4 = Very good, 3 = Good, 2 = Fair, 1 = Poor.

High statistical correlations were obtained between the tender-meter readings of peeled slices and cubes and the pressure tests.

Pit browning. Neubert, *et al* (1948) have reported that the appearance of brown color on at least 5 percent of the pit surface was necessary to assure that the fruit was sufficiently mature to develop good flavor during ripening, but that precise standards could not be established due to seasonal variations. In this study, data obtained on the

TABLE 11—Effect of ripening conditions on wilting loss, pit loss, skin loss, yield and drained weight—Halehaven, 1952

	Days ripened	Wilting loss %			Pit loss %		Skin loss %		Yield		Drained Weight ozs.		Flavor ^a score
		Canned	Frozen	Oz.	Canned	Frozen	Oz.	Canned	Frozen	Oz.	Canned	Frozen	
75° F. Moderate Humidity	6	11.7	7.6	4.2	88.1	35.8	14.3	11.1	3.8	15.4	12.1	2.3	14.4
	8	16.4	7.0	4.8	89.4	37.1	14.8	11.6	3.5	14.8	11.8	2.6	14.1
	10	19.0	8.1	4.2	88.7	36.7	14.8	11.7	2.3	14.8	11.5	2.9	14.1
75° F. High Humidity	6	8.5	7.2	4.0	88.1	36.0	14.0	11.2	3.5	14.4	11.8	3.0	11.8
	8	10.7	7.1	5.0	88.1	35.9	14.4	11.2	3.3	14.5	11.4	2.5	11.5
	10	12.4	7.2	4.9	88.6	36.3	14.5	11.4	2.5	14.5	11.4	2.5	11.5
85° F. Moderate Humidity	6	19.7	8.4	7.0	83.4	31.5	14.8	11.6	3.5	14.1	11.6	3.6	14.3
	8	26.7	8.9	5.0	87.2	35.2	15.3	12.1	1.8	14.1	10.5	3.5	14.1
	10	28.7	9.1	4.8	86.5	34.3	15.4	12.6	1.8	14.0	10.4	3.2	13.9
85° F. High Humidity	6	10.6	6.5	5.6	87.3	35.1	14.1	11.6	3.5	14.4	11.0	3.1	14.4
	8	14.1	7.7	5.0	87.9	35.7	14.6	11.5	2.3	14.4	11.0	3.1	14.3
	10	19.7	7.8	4.3	88.2	35.9	14.8	11.7	1.6	14.0	10.5	3.0	13.9
95° F. Moderate Humidity	6	24.3	8.3	8.5	82.4	30.5	14.5	12.0	1.5	14.6	11.8	2.6	14.6
	8	28.5	9.4	8.1	85.0	30.1	15.2	12.6	1.6	14.3	11.6	2.3	14.3
	10	37.1	10.0	7.5	83.0	32.0	15.5	13.1	1.1	14.2	11.2	2.1	14.2
95° F. High Humidity	6	11.9	7.7	10.3	82.8	31.0	13.3	11.6	1.6	14.1	10.8	3.1	14.1
	8	24.6	7.4	8.3	86.1	32.6	13.6	12.1	1.8	14.0	10.7	3.0	13.9
	10	22.4	8.1	7.5	84.2	32.3	14.0	12.2	1.3	13.8	10.7	3.0	13.8
75° F. Moderate Humidity	3	5.5	6.5	4.5	89.0	36.7	13.4	10.0	4.1	14.6	11.8	2.6	14.6
	5	10.0	6.8	4.0	80.5	37.4	14.0	10.3	4.0	14.6	11.5	2.9	14.1
	7	12.6	5.5	3.9	91.7	39.6	14.3	10.8	3.9	14.8	11.1	3.0	14.1
75° F. High Humidity	3	4.2	6.8	4.3	89.4	37.2	13.8	10.4	4.0	14.4	11.8	2.6	14.4
	5	5.9	6.6	4.3	89.5	37.3	13.8	10.5	4.1	14.4	11.8	2.6	14.4
	7	7.9	6.1	3.8	90.5	38.1	13.8	10.1	3.6	14.4	11.5	2.9	14.1
85° F. Moderate Humidity	3	10.6	7.4	7.1	86.6	34.3	13.9	11.1	3.6	14.1	11.8	3.0	13.9
	5	13.7	6.4	4.5	89.5	37.5	14.4	10.9	3.8	14.0	11.2	2.9	13.9
	7	18.3	7.5	3.8	90.0	37.4	14.5	11.2	2.0	14.0	11.1	2.8	13.9
95° F. Moderate Humidity	3	6.1	6.4	11.0	82.9	31.2	13.8	10.4	3.8	14.4	10.9	3.5	14.4
	5	10.4	6.6	5.9	88.3	36.0	14.0	10.7	2.3	14.5	11.7	2.8	14.5
	7	12.3	6.7	4.9	88.4	36.1	14.0	10.9	2.3	14.5	11.7	2.8	14.5
95° F. High Humidity	3	12.5	6.9	10.2	81.6	29.8	13.9	10.9	3.0	14.4	10.9	3.5	14.4
	5	19.1	7.6	5.9	87.1	33.4	14.4	10.9	3.5	14.5	11.7	3.0	14.5
	7	26.5	7.6	87.4	35.5	14.5	11.7	2.8	2.8	14.5	11.7	3.0	14.5
95° F. High Humidity	3	8.6	6.3	13.6	82.1	28.8	12.8	10.9	2.8	14.4	10.6	3.6	14.4
	5	11.6	6.9	15.4	79.7	27.2	13.1	10.6	1.5	14.3	10.6	3.5	14.3
	7	14.9	6.6	7.5	85.6	36.3	13.3	11.1	1.5	14.5	11.1	3.6	14.5

^a 5 = Excellent, 4 = Very good, 3 = Good, 2 = Fair, 1 = Poor.

percent of pit surface which had browned showed considerable seasonal variation, but in general, the results indicated that peaches should show about 10 percent of the pit surface browned.

Soluble and Total solids. Only slight differences were found in the soluble and total solids of the peaches at various harvest maturities covered in this study (Tables 1-4). The variations obtained in these values showed no definite trend and are probably within the experimental error involved in sampling and analysis.

Wilting losses. The loss in weight of the fruit during handling and ripening often is an important source of loss in the processing of freestone peaches. In these studies, the losses varied from 1 to 18

TABLE 12—Effect of harvest maturity on wilting loss, pit loss, skin loss, yield, drained weight and flavor—Elberta, 1950-52

Days ripened	Wilting loss %			Pit loss %		Skin loss %		Yield		Drained Weight ozs.		Flavor ^a score
	Canned	Frozen	Oz.	Canned	Frozen	Oz.	Canned	Frozen	Oz.	Canned	Frozen	
1950												
13.....	13.3	9.7	4.0	85.8	83.9	14.4	11.8	2.3	11.8	2.6	2.6	...
11.....	12.0	8.4	4.6	87.0	84.8	14.1	11.5	2.9	11.5	2.9	2.9	...
9.....	12.0	6.8	4.2	89.0	86.7	14.0	11.3	3.0	11.3	3.0	3.0	...
7.....	7.3	6.1	3.8	80.1	86.0	13.6	11.1	3.5	11.1	3.5	3.5	...
6.....	5.2	7.0	4.5	88.5	86.0	14.0	10.9	3.2	10.9	3.2	3.2	...
4.....	3.7	6.5	4.5	89.0	86.5	14.0	10.9	3.2	10.9	3.2	3.2	...
3.....	4.1	5.3	4.4	89.4	87.9	13.3	10.9	3.0	10.9	3.0	3.0	...
4.....	3.0	6.2	4.5	89.4	87.1	13.5	11.0	3.0	11.0	3.0	3.0	...
1952												
19.....	19.1	13.0	8.9	82.7	80.9	15.4	12.1	2.3	12.1	2.6	2.6	...
17.....	12.4	13.7	6.1	80.6	79.8	14.8	11.5	2.6	11.5	2.6	2.6	...
14.....	10.2	10.7	4.2	85.2	83.1	14.8	11.1	2.9	11.1	2.9	2.9	...
10.....	7.0	11.8	5.6	82.1	80.1	14.8	10.6	3.0	10.6	3.0	3.0	...
8.....	3.1	10.4	5.5	83.7	82.0	14.4	10.8	3.1	10.8	3.1	3.1	...
6.....	4.9	9.8	4.1	84.1	81.9	14.4	11.0	3.1	11.0	3.1	3.1	...
4.....	3.5	8.1	6.2	85.4	83.4	14.1	10.5	3.5	10.5	3.5	3.5	...
3.....	2.4	8.6	8.3	82.2	81.6	14.0	10.4	3.2	10.4	3.2	3.2	...
2.....	2.5	8.0	5.7	87.0	85.2	13.8	10.0	3.0	10.0	3.0	3.0	...

recent, increasing with increasing ripening times. Losses became excessive only when the peaches required nine days or more to ripen. This emphasizes the undesirability of harvesting fruit in the less mature stages.

Harvest Maturity and Dessert Quality:

Flavor. In general, the best flavor in both canned and frozen samples was obtained with fruit requiring 3 to 7 days to ripen fully.

TABLE 13—Effect of ripening condition^a on wilting loss, pit loss, skin loss, yield and drained weights—Elberta, 1950

Ripening condition	Days ripened	Wilting loss		Pit loss		Skin loss		Yield		Drained Weight		Flavor ^b score
		%	%	%	%	Canned	Frozen %	Canned oz.	Frozen oz.	Canned	Frozen	
75° F. Moderate Humidity	6	17.3	7.6	4.7	87.7	85.6	14.9	10.8	80.9	79.0	15.4	4.0
	8	20.2	7.3	4.0	88.7	86.5	14.5	11.4	82.4	80.4	15.5	3.8
	9	20.0	7.5	4.8	87.7	85.5	14.8	11.4	82.7	80.9	15.8	3.5
75° F. High Humidity	6	12.6	6.9	4.2	88.9	86.8	14.8	10.4	84.2	82.2	14.5	11.1
	8	13.4	6.5	4.7	88.8	86.4	14.3	11.4	84.4	82.4	15.0	11.3
	9	19.3	7.3	4.8	87.9	85.4	14.3	11.6	83.4	83.3	15.0	11.1
85° F. Moderate Humidity	6	19.3	5.7	4.8	89.5	87.4	15.0	11.8	80.9	79.8	15.5	3.6
	8	21.9	6.5	4.0	89.5	87.4	14.6	12.0	81.4	79.4	15.9	2.8
	9	25.4	6.5	4.4	89.1	87.0	14.6	12.3	80.7	80.0	16.1	2.5
85° F. High Humidity	6	15.6	6.6	4.3	89.1	86.9	14.6	11.5	83.7	81.8	14.4	11.3
	8	20.4	7.8	4.9	87.3	85.0	14.3	11.8	82.6	80.7	15.3	2.9
	9	17.6	6.6	4.3	89.1	87.1	14.3	12.0	82.7	80.7	15.3	2.4
95° F. Moderate Humidity	6	21.4	5.9	4.6	89.5	87.3	14.3	12.0	80.9	79.8	15.1	2.9
	8	28.9	8.0	6.4	85.6	83.6	14.5	12.5	79.8	77.5	15.5	2.7
	9	31.0	8.3	6.0	85.7	83.5	14.8	12.5	79.5	77.5	16.3	2.3
95° F. High Humidity	6	17.7	6.6	4.5	88.9	86.7	14.3	11.8	80.9	79.8	13.9	3.0
	8	22.7	7.5	6.6	85.9	83.9	13.6	12.1	79.4	77.9	14.0	2.6
	9	23.8	7.2	5.2	87.6	85.5	13.8	12.1	79.3	77.9	14.0	1.9
75° F. Moderate Humidity	2	6.3	5.9	4.9	89.2	87.0	14.0	10.9	84.4	82.4	14.1	10.1
	4	11.9	6.6	5.1	88.4	86.2	14.0	10.6	84.7	82.7	14.6	10.5
	5	14.0	6.4	5.4	89.2	86.9	13.9	11.3	87.2	85.1	14.9	11.1
85° F. Moderate Humidity	2	3.2	5.5	5.4	89.1	86.8	13.9	10.6	83.5	81.5	14.4	10.5
	4	7.5	5.8	4.8	89.4	87.1	13.8	11.1	84.1	82.3	14.1	9.9
	5	8.1	5.9	4.3	89.8	86.7	13.8	11.0	84.7	82.7	14.5	10.4
85° F. High Humidity	2	8.1	5.5	5.5	88.8	87.0	14.1	11.1	84.7	82.7	14.5	9.6
	4	15.8	6.9	4.9	88.2	86.0	14.3	11.3	84.7	82.7	14.8	10.1
	5	19.2	6.8	4.8	88.6	86.5	14.4	10.4	84.7	82.7	15.5	9.9
95° F. High Humidity	2	3.6	5.6	5.4	89.0	86.7	13.9	10.9	84.7	82.7	13.5	3.5
	4	13.7	6.4	5.1	88.5	86.3	13.9	10.9	84.7	82.7	13.8	3.2
	5	10.9	6.2	5.6	88.2	86.0	14.0	11.4	84.7	82.7	14.5	2.6

* 5 = Excellent, 4 = Very good, 3 = Good, 2 = Fair, 1 = Poor.

TABLE 14—Effect of ripening condition on wilting loss, pit loss, skin loss, yield, drained weight and flavor—Elberta, 1951

Ripening condition	Days ripened	Wilting loss		Pit loss		Skin loss		Yield		Drained Weight		Flavor ^a score
		%	%	%	%	Canned	Frozen %	Canned oz.	Frozen oz.	Canned	Frozen	
75° F. Moderate Humidity	8	20.6	11.2	6.3	80.9	79.0	15.4	12.0	4.0	4.0	11.5	3.8
	10	23.0	11.3	5.2	82.4	80.4	15.5	11.5	4.0	4.0	11.5	3.8
	12	26.3	11.7	5.5	82.7	80.9	15.8	12.0	4.0	4.0	11.5	3.5
75° F. High Humidity	8	9.9	9.8	5.2	84.2	82.2	14.5	11.1	4.0	4.0	11.3	3.9
	10	10.3	9.8	5.0	84.4	82.4	15.0	11.3	4.0	4.0	11.3	3.9
	12	13.5	9.8	4.6	85.3	83.3	15.0	11.1	4.0	4.0	11.3	3.9
85° F. Moderate Humidity	8	22.7	10.4	6.5	80.9	79.8	15.5	12.3	2.8	2.8	12.3	2.5
	10	27.8	12.0	5.6	81.4	79.4	15.9	12.3	2.8	2.8	12.3	2.5
	12	32.7	12.8	6.6	80.7	80.0	16.1	12.6	2.5	2.5	12.6	2.5
85° F. High Humidity	8	13.5	9.9	6.3	83.7	81.8	14.4	11.3	3.6	3.6	11.5	3.6
	10	16.2	9.9	7.0	84.5	82.6	15.3	12.0	3.6	3.6	12.0	3.5
	12	20.1	10.5	5.9	82.7	80.7	15.3	11.3	3.6	3.6	11.3	3.5
95° F. Moderate Humidity	8	29.8	11.5	8.8	76.8	76.0	15.1	12.1	2.9	2.9	12.1	2.9
	10	34.0	12.2	7.6	79.0	77.5	15.5	12.0	2.9	2.9	12.0	2.9
	12	65.7	13.0	9.4	76.5	74.7	16.3	12.8	2.3	2.3	12.8	2.3
95° F. High Humidity	8	12.2	9.6	10.1	71.5	70.2	13.9	11.3	3.0	3.0	11.3	3.0
	10	15.9	10.2	9.4	79.7	77.9	14.0	11.3	3.0	3.0	11.3	3.0
	12	21.8	10.4	6.6	82.0	80.0	14.5	11.5	3.0	3.0	11.5	3.0
75° F. Moderate Humidity	3	7.1	8.8	6.9	84.4	82.4	14.1	10.1	4.3	4.3	10.4	4.3
	5	11.4	8.0	4.7	86.7	84.6	14.6	10.5	4.2	4.2	10.5	4.2
	7	15.8	8.5	4.4	87.2	85.1	14.9	11.1	4.0	4.0	11.1	4.0
75° F. High Humidity	3	3.1	7.7	6.3	85.5	83.3	14.1	9.9	4.4	4.4	10.4	4.4
	5	4.4	8.2	5.1	86.4	84.5	14.3	10.4	4.3	4.3	10.4	4.3
	7	5.8	7.9	4.6	87.3	85.1	14.1	10.1	4.2	4.2	10.1	4.2
85° F. Moderate Humidity	3	9.7	8.3	6.9	83.5	81.5	14.4	10.5	4.0	4.0	10.5	4.0
	5	14.8	9.1	5.5	85.5	83.1	15.0	11.4	3.7	3.7	11.4	3.7
	7	18.9	9.0	4.9	85.9	83.5	15.3	11.0	3.4	3.4	11.0	3.4
85° F. High Humidity	3	5.5	8.1	8.0	84.1	82.3	14.4	9.6	4.1	4.1	10.4	4.1
	5	9.5	8.9	4.8	84.7	82.7	14.5	10.4	3.8	3.8	10.4	3.8
	7	13.0	8.1	5.2	86.3	84.1	14.9	10.5	3.5	3.5	10.5	3.5
95° F. Moderate Humidity	3	12.8	8.7	13.1	76.9	75.1	14.1	10.4	3.8	3.8	11.1	3.8
	5	19.3	8.2	8.9	84.1	82.0	14.8	11.1	3.9	3.9	11.6	3.9
	7	25.4	9.5	6.5	82.0	80.1	15.5	11.6	3.2	3.2	11.6	3.2
95° F. High Humidity	3	7.0	8.4	14.7	75.7	73.8	13.5	10.1	3.5	3.5	10.1	3.5
	5	11.3	8.3	10.2	79.9	78.1	13.8	10.5	3.2	3.2	10.5	3.2
	7	17.2	8.8	7.2	83.3	81.3	14.5	11.0	2.6	2.6	11.0	2.6

The results of the 3-years' study (Tables 9 and 12) showed that peaches do not have to be left on the tree until they are "tree ripe" or within 3 days or less of full ripeness to obtain good quality and flavor in the processed product. Peaches requiring 8 or more days to ripen after harvest were inferior in quality and tended to be astringent, while those requiring less than 3 days lacked good peach flavor.

These results are in general agreement with those obtained by Newbert *et al* (1948) on Washington freestone peaches.

Texture. The fruit became softer with increasing ripeness at harvest. The range in which good texture was obtained was rather wide. It was generally considered undesirable firm in fruit requiring 10 days or longer to ripen, and soft and fibrous in samples requiring 3 days or less to ripen. These differences were more pronounced in the canned peaches than in the frozen peaches. The texture of both Halehaven and Elberta were similar.

Color. The intensity of the yellow color tended to become greater with increased cabinet ripening time, although the differences were not marked.

Handling qualities. The peaches retained enough firmness to permit harvesting and handling without excessive bruising until they reached a maturity requiring 4 days or less to ripen. Fruit requiring

TABLE 16—Effect of ripening condition on wilting loss, pit loss, skin loss, yield, drained weight and flavor—Elberta, 1952

Ripening condition	Days ripened	Wilting loss %		Pit loss %		Skin loss %		Yield Canned %		Drained Weight ozs.		Flavor score		
		75° F.	Moderate Humidity	75° F.	High Humidity	75° F.	High Humidity	85° F.	Moderate Humidity	85° F.	High Humidity	95° F.	Moderate Humidity	95° F.	High Humidity
75° F.	4	4.9	7.0	4.7	7.0	4.7	7.0	91.6	84.7	13.5	10.5	4	4	4
Moderate Humidity	6	7.5	6.4	5.1	8.1	6.9	5.8	89.3	85.4	14.0	10.9	3	3	3
7	8.1	6.0	5.8	10.8	6.0	4.9	89.4	86.3	14.0	10.9	3	3	3	
Humidity	8	8.3	6.0	4.8	8.3	6.1	4.8	91.5	83.7	13.4	10.4	4	4	4
75° F.	4	2.9	6.4	4.7	6.0	4.7	6.0	88.3	82.7	13.9	10.7	3	3	3
High Humidity	6	4.8	6.0	5.8	8.3	6.1	5.8	80.8	81.0	13.9	10.7	3	3	3
7	7.3	7.3	5.9	10.7	7.3	6.3	84.5	86.4	14.3	10.9	3	3	3	
Humidity	8	9.4	6.1	6.3	20.3	7.1	6.0	85.9	86.1	15.1	11.1	2	2	2
85° F.	4	9.7	6.8	5.4	15.1	6.7	5.9	91.2	87.3	13.9	10.7	4	4	4
Moderate Humidity	6	15.1	6.0	5.8	17.3	7.3	6.8	82.9	83.2	14.7	11.1	3	3	3
7	20.3	7.1	6.0	20.3	7.1	6.0	85.9	86.1	15.1	11.1	2	2	2	
Humidity	8	20.3	7.1	6.0	20.3	7.1	6.0	85.9	86.1	15.1	11.1	2	2	2
95° F.	4	4.7	6.2	5.5	13.1	7.5	7.5	89.2	85.6	13.1	10.1	4	4	4
High Humidity	6	7.5	6.4	6.3	9.4	6.7	6.3	85.4	82.4	13.9	10.8	3	3	3
7	10.4	6.7	6.3	12.3	7.3	6.8	87.3	84.4	14.0	11.2	3	3	3	
Humidity	8	12.3	7.3	6.8	22.6	8.3	7.7	85.8	80.0	14.3	10.7	3	3	3
95° F.	4	12.0	7.0	7.5	12.0	7.0	7.5	85.6	84.0	13.3	10.9	3	3	3
Moderate Humidity	6	13.1	6.8	7.5	20.4	7.5	7.0	87.4	83.3	13.8	11.1	3	3	3
7	20.4	7.5	7.0	20.4	7.5	7.0	86.4	82.4	13.9	11.3	2	2	2	
Humidity	8	22.6	8.3	7.7	22.6	8.3	7.7	84.7	82.2	14.3	11.6	2	2	2
95° F.	4	4.9	6.7	12.1	10.5	6.8	6.4	77.6	79.1	12.7	10.3	2	2	2
High Humidity	6	8.8	8.2	8.2	12.9	6.6	6.6	83.4	81.6	12.7	11.1	3	3	3
7	10.5	7.2	6.8	12.9	7.2	6.6	87.7	83.3	13.1	10.9	3	3	3	
Humidity	8	12.9	6.0	6.6	12.9	6.0	6.0	87.5	87.9	13.2	11.1	2	2	2

* 5 = Excellent, 4 = Very good, 3 = Good, 2 = Fair, 1 = Poor.

TABLE 17—Effect of years on Halehaven peaches

Ripening condition	Days ripened	Wilting loss %		Pit loss %		Skin loss %		Yield Canned %		Drained Weight ozs.		Flavor score	
		1951	1952	1951	1952	1951	1952	1951	1952	1951	1952		
75° F.	7	10.9	8.4	5.1	8.7	84.0	14.1	10.4	4.2	10.8	7.60	1.5	
Moderate Humidity	9	12.9	8.5	4.7	85.2	85.6	14.2	10.8	3.7	6.43	0.0		
11	15.3	8.9	5.2	83.2	82.1	14.6	10.9	3.3	85.38	0.6			
13	18.2	9.0	7.7	80.6	77.1	14.4	11.0	3.0	81.84	3.4			
75° F.	7	6.4	8.2	4.6	87.6	85.2	14.3	10.5	4.0	25.23	4.4		
High Humidity	9	7.6	7.9	5.1	90.5	83.4	14.2	10.8	3.4	40.16	25.0		
11	9.0	8.7	5.7	86.8	80.9	14.3	10.7	3.4	16.57	9.8			
13	11.3	7.9	8.9	74.7	79.7	14.1	10.6	3.0	26.86	21.20			
85° F.	7	20.3	9.0	5.5	87.4	85.1	15.1	11.4	3.2	14.50	14.31		
Moderate Humidity	9	23.4	9.8	6.3	85.4	80.8	15.0	11.2	2.8	28.31	28.31		
11	27.5	10.6	6.0	82.5	77.6	15.4	11.8	2.7	40.16	33.08			
Humidity	13	11.3	7.9	8.9	74.7	79.7	14.1	10.6	3.0	12.46	16.57		
75° F.	7	9.2	8.0	5.3	87.6	83.8	14.1	10.9	3.5	81.84	83.59		
High Humidity	9	9.6	8.4	5.8	86.2	84.3	14.1	11.0	3.3	25.23	28.31		
11	11.9	8.9	5.9	84.1	84.1	14.0	11.1	3.2	40.16	33.08			
13	15.6	8.9	7.3	76.9	84.7	14.3	11.5	2.8	6.58	6.43			
85° F.	7	26.0	9.7	8.1	82.7	79.8	14.3	11.9	3.3	85.38	85.97		
Moderate Humidity	9	29.0	10.2	8.7	81.9	72.1	14.2	12.0	2.8	81.84	83.59		
11	33.8	11.1	7.4	75.4	73.7	15.1	12.4	2.3	26.86	21.20			
95° F.	7	11.1	8.2	12.8	79.4	78.4	13.3	11.1	3.0	14.50	14.31		
High Humidity	9	14.5	8.2	7.3	86.1	81.9	13.4	11.4	2.6	10.65	11.13		
11	17.4	8.6	8.2	84.7	84.3	14.2	11.9	2.3	7.2	7.2	7.2		
Humidity	13	20.6	8.6	7.9	86.0	81.8	14.4	11.8	2.1				

* 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Fair, 1 = Poor.

**Significant 5% level.

***Significant 1% level.

TABLE 18—Effect of years on Elberta peaches

	1950	1951	1952	F value	L.S.D.
Pit loss.....%	8.24	7.15	8.04	7.43	8.51
Skin loss.....%	6.53	4.42	5.48	5.48	8.56
Yield, canned.....%	85.37	88.08	88.00	86.64	95.48
Total loss, canned.....%	83.55	85.34	85.09	87.05	86.64
Total loss, frozen.....%	26.16	24.83	21.95	27.25	24.07
Net loss, canned.....%	13.51	31.01	31.27	35.77	33.94
Net loss, frozen.....%	1.71	1.29	1.36	1.36	1.36
Drained weight, canned.....oz.	....	....	....	....	....
Drained weight, frozen.....oz.	....	....	....	....	....

*Significant 5% level.
**Significant 1% level.

4 days or less to ripen should be harvested and handled with extreme care to prevent excessive bruising. The freeness of pits and the ease with which the skins could be removed was similar for the maturity ranges covered in this study.

RIPENING STUDY

The ripening process in peaches may take place either on or off the tree. Since it is not practical to harvest tree-ripened fruit commercially, it is necessary to ripen the fruit after harvest for processing. The conditions under which the peaches are ripened affects the dessert quality of the processed product. At the present time, there is no agreement as to the optimum conditions for ripening the fruit (Haller, 1952).

Studies were made during the 1950, 1951 and 1952 seasons on the methods of ripening Elberta and Halehaven peaches. Ripening temperatures used were 75°, 85° and 95° F. under conditions of moderate and high relative humidity.

EXPERIMENTAL PROCEDURE

Fruit selection. The peaches used in the ripening study were obtained from the same orchard as those for the harvest maturity study. Two maturities were used and the fruit was composited to secure as uniform a maturity as possible within each maturity. About

TABLE 19—Effect of ripening conditions on Halehaven peaches

	Room temperature	75° F.	85° F.	95° F.	F value	L.S.D.
Pit loss.....%	8.32	8.00	7.41	8.31	7.72	8.66
Skin loss.....%	5.65	5.08	5.07	5.81	5.72	7.68
Yield, canned.....%	86.74	86.80	87.44	86.14	87.85	8.80
Total loss, canned.....%	26.83	22.83	25.63	28.12	25.32	15.03**
Net loss, canned.....%	1.71	1.77	1.92	1.46	1.46	0.85
Yield, frozen.....%	84.16	84.31	87.44	86.59	83.35	15.03**
Total loss, frozen.....%	22.87	34.15	30.84	22.00	34.08	15.03**
Net loss, frozen.....%	1.71	1.77	1.92	1.46	1.46	0.85
Drained weight, canned.....oz.	....	....	....	....	....	....
Drained weight, frozen.....oz.	....	....	....	....	....	....

TABLE 20—Effect of ripening conditions on Elberta peaches

	Room temperature	75° F.	85° F.	95° F.	F value	L.S.D.
Pit loss.....%	8.32	8.00	7.41	8.31	7.72	8.66
Skin loss.....%	5.65	5.08	5.07	5.81	5.72	7.68
Yield, canned.....%	86.74	86.80	87.44	86.14	87.85	8.80
Total loss, canned.....%	26.83	22.83	25.63	28.12	25.32	15.03**
Net loss, canned.....%	1.71	1.77	1.92	1.46	1.46	0.85
Yield, frozen.....%	84.16	84.31	87.44	86.59	83.35	15.03**
Total loss, frozen.....%	22.87	34.15	30.84	22.00	34.08	15.03**
Net loss, frozen.....%	1.71	1.77	1.92	1.46	1.46	0.85
Drained weight, canned.....oz.	....	....	....	....	....	....
Drained weight, frozen.....oz.	....	....	....	....	....	....

*Significant 5% level.
**Significant 1% level.

Pit loss.....%
Skin loss.....%
Yield, canned.....%
Total loss, canned.....%
Net loss, canned.....%
Yield, frozen.....%
Total loss, frozen.....%
Net loss, frozen.....%
Drained weight, canned.....oz.
Drained weight, frozen.....oz.

Net loss, canned.....%
Yield, canned.....%
Total loss, canned.....%
Net loss, canned.....%
Yield, frozen.....%
Total loss, frozen.....%
Net loss, frozen.....%
Drained weight, canned.....oz.
Drained weight, frozen.....oz.

Pit loss.....%
Skin loss.....%
Yield, canned.....%
Total loss, canned.....%
Net loss, canned.....%
Yield, frozen.....%
Total loss, frozen.....%
Net loss, frozen.....%
Drained weight, canned.....oz.
Drained weight, frozen.....oz.

pounds of fruit were accurately weighed into each of the trays, and these trays were placed into the ripening cabinets within 6 hours after the fruit was picked.

Fruit description. Determinations were made on representative samples from each lot as described for the harvest maturity study.

Ripening methods. The fruit was ripened in cabinets that held about 10 pounds of fruit. The cabinets were constructed of waterproofed plywood and were well insulated. Electrical heating elements, a thermo-regulator and a small fan were used to obtain a uniform controlled temperature. Relative humidity was controlled at two general levels with vents. When the cabinets were fully loaded and all vents closed, a relative humidity of 90 to 98 percent was obtained. The temperature and humidity ranges obtained are summarized in Table 7.

Processing. One tray of peaches of each maturity was removed from each cabinet at each processing time. An attempt was made to move the first fruit about 1 day before comparable fruit held at 70° F. under conditions of high relative humidity had reached processing ripeness. Successive trays were removed at 2-day intervals. Upon removal from the cabinets, the fruit was weighed to determine loss in weight, and all lots were compared for color and processed in the harvest maturity study. Observations were made on the cutting, peeling and general character of the fruit; and pit and skin loss and yield data were obtained.

TABLE 21—Comparison of Halehaven and Elberta peaches analyses of variance

	Halehaven	Elberta	F value
t loss.....	8.08	8.10	0.01
in loss.....	6.49	6.12	1.49
eid, canned.....	85.78	85.98	0.21
eld, frozen.....	83.14	83.58	1.10
tal loss, canned.....	27.34	26.74	0.48
tal loss, frozen.....	34.95	32.41	4.26*
et loss, canned.....	15.86	14.85	2.60
et loss, frozen.....	22.70	20.22	10.43**
rained weight, canned.....	14.20	14.24	0.06
rained weight, frozen.....	11.00	11.11	1.70

*Significant 5% level.

**Significant 1% level.

Processed fruit. The canned and frozen samples were evaluated as described for the harvest maturity study. Comparisons were made to determine the best ripening time under each ripening condition and to determine the best ripening condition. Data were obtained on drained weight.

DISCUSSION OF RESULTS

Fruit Descriptions: The fruit descriptions are summarized in Table 8. **Wilting loss during ripening:** The wilting losses ranged from 4 to 38 percent, depending on the ripening condition and time (Tables 10, 11, 13-16). Higher losses occurred in the peaches ripened under moderate humidities than in those ripened at high humidities. Peaches ripened at 95° F. at moderate humidity had the greatest wilting loss. These results emphasized that to prevent serious losses from wilting during ripening, it is desirable to ripen peaches at moderate temperatures (70° to 80° F.) and pick the fruit at maturities requiring 7 days or less to ripen.

Peeling and Pitting: The ripening conditions had a distinct effect on the ease with which the skins were removed. In general, the skins slipped more readily from the fruit ripened at the lower temperature. At 85° F. and 95° F. longer ripening periods were required before the peels slipped readily, and this was most pronounced at 95° F. under high humidity.

The peel loss of the Halehaven generally decreased with increased ripening time, while those of the Elberta tended to increase. The skin on the highly blushed portions of the Halehaven was very tender and fragmented in peeling.

The freeness of the pits was not noticeably affected by the ripening conditions. The pit loss increased with increased ripening time.

RIPENING METHOD AND DESSERT QUALITY

Flavor: The flavor of the canned and frozen peaches was markedly influenced by the method of ripening. In general, the best flavor was obtained in fruit ripened at the lower temperatures, and this flavor was maintained over a relatively long period of ripening. The fruit ripened at 85° F., when the ripening period was relatively short, was almost equal in flavor to that ripened at lower temperatures.

Peaches requiring longer ripening times or with prolonged ripening times tended to develop a stale or over-ripe flavor. At 95° F. the

fruit developed the stale or over-ripe flavor much earlier, and this tended to be more pronounced in those ripened at high humidity. In the peaches requiring longer ripening time, the stale or over-ripe flavor tended to develop before they reached processing ripeness.

These results emphasize the desirability of ripening peaches at the lower temperatures (70° - 80° F.) to avoid development of stale or over-ripe flavor and, if necessary, to permit holding the riper fruit until the slightly greener fruit reached processing ripeness.

Texture: The texture of the canned or frozen fruit showed no marked differences between the different ripening conditions.

Color: The color of the processed fruit was influenced by both the length of ripening time and ripening conditions. The depth of yellow color increased with an increase in the length of the ripening period, but fruit ripened for longer periods of time at 85° and 95° F. developed an unattractive orange-yellow color.

With equal times of ripening, a deeper yellow color developed as the temperature of ripening increased, and with any one ripening temperature, the peaches held at a high relative humidity had a deeper yellow color than fruit held at moderate humidity.

The higher ripening temperatures also increased the red color of the pit cavity. At 95° F. with longer ripening times, red color diffused into the surrounding tissue. There was also a tendency for the red color to become brown in the canned samples.

In general, the processed fruit from peaches ripened at 70° to 75° F. varied from light to medium, with slightly deeper color under conditions of high relative humidity. At 85° F. under moderate humidity conditions, the color varied from light yellow to orange and at 95° F. from medium yellow to deep orange. Under high relative humidities, it was slightly deeper in corresponding fruit.

These data indicate that the depth of yellow color in the product may be controlled by varying the conditions of ripening. However, it must be emphasized that it is essential to ripen the fruit until all the green color has disappeared in order to avoid green color in the final product and to assure good flavor. Prolonged ripening at excessively high temperatures should be avoided because of the development of an undesirable orange color.

EFFECT OF HARVEST MATURITY AND RIPENING CONDITIONS ON PIT LOSS, SKIN LOSS, YIELD, TOTAL LOSS, NET LOSS AND DRAINED WEIGHT

The data obtained for Halehaven are summarized in Tables 9, 10 and 11 and for Elberta in Tables 12 to 16, and the statistical analyses are presented in Tables 17 to 21.

Pit Loss: The pit loss of the Halehaven fruits was similar for both 1951 and 1952. Significantly higher pit losses were obtained for the Elberta in 1951 than either in 1950 or 1952, and the loss was higher in 1952 than in 1951. Covariance analysis showed that the pit loss differences could not be attributed to the effect of different wilting losses. No significant differences were found between the ripening conditions for either variety and the losses were similar for both varieties.

The regression of pit loss on wilting loss is presented in Fig. 3. The correlation was above that required for significance at the 1 percent level. These data indicated a pit loss of 6 to 7 percent regardless of the wilting loss.

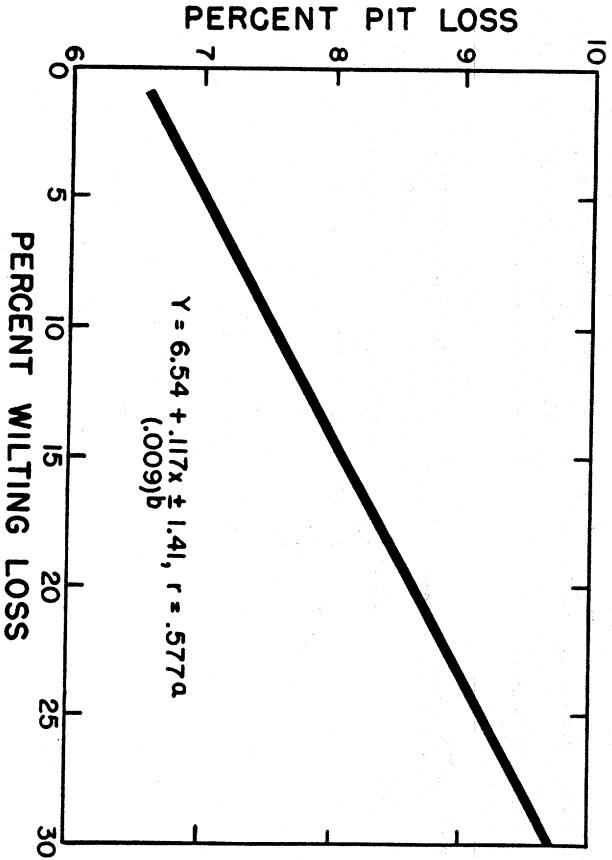


Fig. 3. Regression of pit loss on wilting loss.

^a Significant 1 % level

^b Standard error of regression coefficient

Skin Loss: No differences in skin losses were obtained for Halehaven, while those of Elberta were significantly lower in 1950 than in 1951 or 1952. Fruit ripened at 95° F., either at moderate or high relative humidity, had significantly higher skin losses and the highest losses occurred under high humidity conditions. Similar results were obtained for both varieties.

Yield: The ripened fruit was weighed before and after preparation for canning or freezing to determine the yield. The yields for Halehaven were similar for 1951 and 1952. Higher yields were obtained for Elberta in 1950 than in 1951 or 1952. There was no significant difference between the two varieties. The frozen peach yields averaged about 2.5 percent less than those of the canned peaches because of the loss occurring in the slicing operation.

The yields of both varieties ripened at 95° F. were significantly lower than those ripened at lower temperatures.

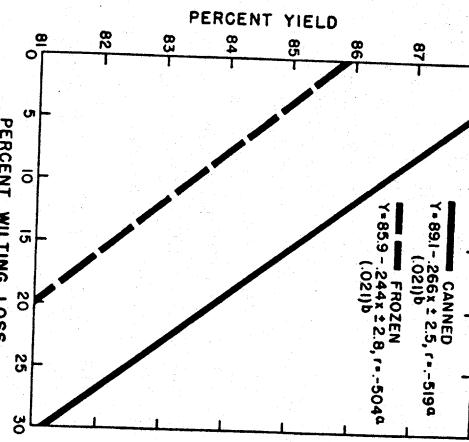
High significant correlations were obtained between wilt loss and yield (Fig. 4). The results indicated that the maximum yields that might be expected were 88 and 85 percent, respectively, for the canned and frozen peaches.

Total loss: The total loss includes wilting loss and the difference between ingoing and drained weights. The results indicated that the maximum yields that might be expected were 88 and 85 percent, respectively, for the canned and frozen peaches.

The total loss for the canned Halehaven was greater in 1952 than in 1951, while the opposite was found for the frozen peaches.

No significant differences were found between the years for the canned Elbertas. For the frozen samples, the highest total loss occurred in 1951 and the least in 1950.

Fig. 4. Regression of yield on wilting loss.
a Significant 1% level
b Standard error of regression coefficient



The total losses were similar for the canned samples of the two varieties but those of the frozen Elberta were significantly lower than those of the Halehaven.

The regressions of total loss on wilting loss are presented in Fig. 5. The data obtained indicated that the total loss would be about 20 and 28 percent, respectively, for canned and frozen peaches regardless of wilt loss.

Net loss: Net loss includes wilting loss and the difference between ingoing and drained weights. The canned Halehavens had a greater net loss in 1952 than in 1951, while the opposite was the case for the frozen samples. The least loss occurred in the canned Elbertas in 1951 and in the frozen lot in 1950. The largest net loss occurred in the lots ripened at 95° F. under moderate humidity conditions.

In general, Halehaven had a greater net loss than Elberta, but the difference was only significant in the frozen samples. The results obtained indicated that a net loss of about 8 percent for canned peaches and 15 to 17 percent for frozen peaches can be expected regardless of loss of weight by wilting (Fig. 6).

Drained weight. The drained weights of the canned Halehavens were slightly higher in 1951 than in 1952, while those humidities were higher than those at high relative humidities.

A comparison of the ripening conditions showed that the greater losses occurred in the fruit ripened at 95° F., and that the losses under moderate relative humidities were higher than those at high relative humidities.

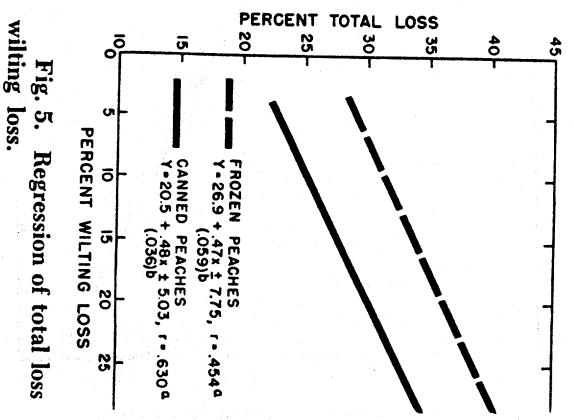


Fig. 5. Regression of total loss on wilting loss.
a Significant 1% level
b Standard error of regression coefficient

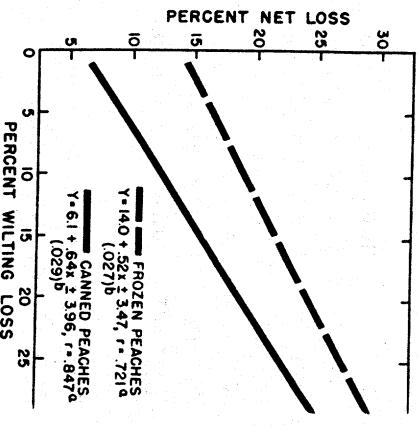


Fig. 6. Regression of net loss on wilting loss.
a Significant 1% level
b Standard error of regression coefficient

nificantly lower. The highest drained weights were obtained for the canned Elbertas in 1951 and for the frozen samples in 1950, with the lowest for both in 1952.

Significantly lower drained weights were obtained for the canned peaches ripened at 95° F. under conditions of high humidity. This difference was not obtained in the frozen peaches. Apparently the tissue of the fruit ripened at this high temperature and humidity was so altered that the ability of the halves to recover from the wilting loss during canning and storage was impaired. The drained weights of the two varieties were similar.

The regression of drained weight on wilting loss is presented in

Fig. 7. With a wilting loss of 3 to 5 percent that may be expected in harvesting and handling peaches requiring 2 to 4 days to ripen, the drained weight of canned peaches averaged 13.7 ounces with an ingoing weight of 14.5 ounces. To obtain a drained weight equivalent to that of the ingoing weight, a wilting loss of about 18 percent

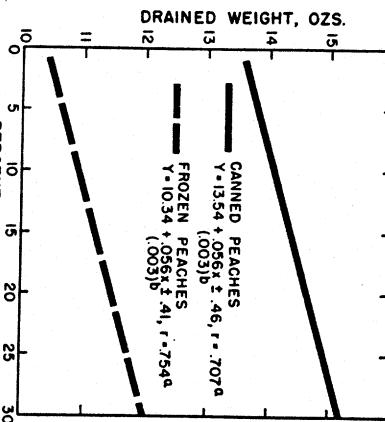


Fig. 7. Regression of drained weight on wilting loss.

^a Significant 1% level
^b Standard error of regression coefficient

necessary to obtain a drained weight equivalent to the ingoing weight of 12 ounces.

SUMMARY

The results of studies during 1950, 1951 and 1952 on the relation of harvest maturity and ripening conditions to quality of canned and frozen peaches are presented.

Peaches should be harvested at a maturity requiring 3 to 7 days' ripening for processing in order to obtain the highest quality and best yield in both the canned and frozen product.

A pressure test standard cannot be established that will insure

the harvesting of all peaches at the proper maturity. The results indicated, however, that peaches testing more than 12 pounds on pared cheeks with 5/16-inch plunger will not ripen to give a high quality product.

Ground color is not a reliable index of maturity because it fluctuates from year to year. However, used in conjunction with the pressure test it will provide an index for the pickers to use.

Weight, ring size, circumference and diameters do not provide a means for determining the maturity at which peaches should be harvested and only indicate the maturation of the peach.

Peaches ripened at 70° to 75° F. were found to have the best quality and this quality was maintained over a relatively long period of ripening. Higher ripening temperatures resulted in the development of stale or "over ripe" flavor unless the ripening period was relatively short. This was most pronounced in fruit ripened at high relative humidity.

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